NPS Technical Comment #1

NUMERICAL GROUNDWATER FLOW MODELING REPORT AND GROUNDWATER MODEL COMMENTS

The National Park Service has identified three key numerical model flaws with the first listed being fundamental and fatal to the model. They are:

1) Groundwater flow is much more highly constrained/distorted in model output from both reality and what stakeholders were led to believe in that internal model cross sections strongly contradict the "Schematic Cross-Section of Geology and Model Layers" presented in the Numerical Groundwater Flow Modeling Report (Appendix L p. 3-3). Internal model cross sections show extreme thinning and thickening of model layers across the model domain which cannot be supported by the stratigraphy of the surficial aquifer observed in site borehole logs. Extreme thickening and thinning of model layers that is not real would be expected to distort groundwater flow from any true approximation of the flow system, the stated model objective.

AECOM uses the above Appendix L schematic as their conceptual basis for relating the site geology or stratigraphy of the surficial aquifer to their four-layer hydrostratigraphy used in the model. The "layer cake" relative consistency in each model layer thickness (particularly for model layers 2, 3 and 4 that are less affected by surface topography and recent depositional events) that was depicted in the schematic, should be expected for the site based on USGS published data. However, a reasonable consistency in layer thickness was not honored in model construction. This has resulted in a significant potential for distortion of groundwater flow from reality and a deviation from that expected based on the local potentiometric surface gradients. NPS found AECOM's Appendix L schematic to be a reasonable and accurate conceptual basis for the modeling approach. However, large variations in thickness of each layer throughout the model domain is apparent in model cross sections, is unsupported by the stratigraphy observed in site boreholes, and will have a pronounced affect on the transmissivity of each model layer. These false stratigraphic constructs internal to the model will create an inaccurate depiction of site groundwater flow because aquifer and layer transmissivity is highly sensitive to layer thickness ($T=Kb$) and a key component of the groundwater flow equation calculated at model nodes.

The degree to which the unsupported/arbitrary changes in model layer thickness across the model domain have resulted in significant manipulation or the distortion of simulated groundwater flow paths is not known at this time. These artificial model constructs are sufficient basis alone to reject this model and even more so when PRP contractors have previously restricted COC movement from Yard 520 to a single model layer (Layer 4) and then subsequently directing this groundwater flow/contaminant migration further by arbitrarily "thinning/pinching out" the Layer 4 hydrostratigraphic unit.

Review of the North Yard 520 area Layer 4 transmissivity contour map coupled with model cross sections indicates abrupt changes in model layer thickness are the primary reason for the distortions in transmissivity and they occur in the areas most crucial to NPS understanding of the risk to its resources. While adjoining model layers may have equivalent horizontal hydraulic conductivity values, vertical flow to adjacent layers is restricted by the horizontal to vertical hydraulic conductivity ratios on the order of 100:1. Thus, when a stratigraphic pinchout occurs in a model layer having COCs, as it does near the North cell boundary in Layer 4, this condition will arbitrarily restrict flow in the down gradient direction (north and northwest) and thereby favor or "force" flow to occur at right angles to the local gradient. This key stratigraphic element controlling flow was never acknowledged nor discussed by the AECOM Hydrogeologist despite multiple discussions with stakeholders intended to clarify factors controlling the sharp NE bending of particle tracking to Brown Ditch that was incompatible with the local gradient.